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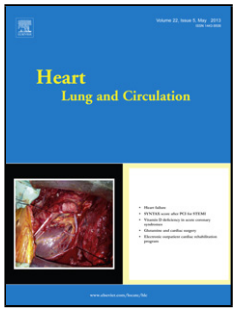

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Simultaneous Transseptal Para-Ring Leak Closure and Transcatheter Mitral Valve Implantation for the Treatment of Surgical Mitral Repair Failure

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Abstract

Repeat cardiac surgery in patients with a previous sternotomy is associated with significant morbidity and mortality. While transcatheter aortic valve implantation in high risk surgical patients is now well established [1,2], experience with transcatheter mitral valve replacement is still at an early stage. Although many successful reports of transcatheter mitral valve replacements now exist, the predominant approach has been via a transapical approach[3]. It is likely that, as with the evolution of favoured access routes for transcatheter aortic therapies, future directions for transcatheter mitral valves will focus on smaller delivery systems favouring the transvenous transseptal approach where possible. We present the first reported case of combined transseptal para-ring leak closure followed by transcatheter mitral valve implantation using a 12/5 mm Amplatzer III vascular plug and a 29 mm SAPIEN 3 valve.

Keywords

Mitral valve replacement; Valve-in-valve; Paravalvular leak

Simultaneous Transseptal Para-Ring Leak Closure and Transcatheter Mitral Valve Implantation for the Treatment of Surgical Mitral Repair Failure

We describe a successful case of combined transseptal para-ring leak closure and transcatheter mitral valve implantation (valve-in-ring) for the treatment of a symptomatic 57-year-old man with a failed mitral valve repair and annuloplasty ring 18 months prior. At the end of the procedure, transoesophageal echocardiography confirmed that the valve was in a good position with no significant residual mitral regurgitation. The patient was discharged home the following day. This is the first reported case of combined transseptal para-ring leak closure followed by transcatheter mitral valve implantation with an Edwards SAPIEN 3 valve.

Introduction

Repeat cardiac surgery in patients with a previous sternotomy is associated with significant morbidity and mortality. While transcatheter aortic valve implantation in high risk surgical patients is now well established [1,2], experience with transcatheter mitral valve replacement is still at an early stage. Although many successful reports of transcatheter mitral valve replacements now exist, the predominant approach has been via a transapical approach[3]. It is likely that, as with the evolution of favoured access routes for transcatheter aortic therapies, future directions for transcatheter mitral valves will focus on smaller delivery systems favouring the transvenous transseptal approach where possible. We present the first reported case of combined transseptal para-ring leak closure followed by transcatheter mitral valve implantation using a 12/5 mm Amplatzer III vascular plug and a 29 mm SAPIEN 3 valve.

Case Report

A 57-year-old man presented with progressive dyspnoea (New York Heart Association class III). The patient had undergone mitral valve repair with a 30 mm annuloplasty ring and single coronary artery bypass 18 months prior, in 2015. Other medical background included a previous inferior myocardial infarct and aneurysm, ventricular tachycardia with dual chamber defibrillator insertion and a previous embolic stroke complicating coronary angiography in 2015.

Echocardiography demonstrated moderate left ventricular impairment with an inferior aneurysm and an ejection fraction of 35%. There was severe mitral regurgitation (MR) secondary to a posteriorly located para-ring leak (Figure 1). Coronary angiography revealed patent bypass grafts with no significant disease. His operative risk was deemed to be high with a Society of Thoracic Surgeons (STS) score of 19.98%. The consensus of our multidisciplinary heart team meeting was to proceed with a combined transseptal para-ring leak closure and transcatheter approach.

The procedure was performed in a hybrid catheter laboratory and the cardiac surgeons were available for redo surgery as a bailout strategy if required. The procedure was performed under general anaesthesia with fluoroscopic and transoesophageal echocardiography (TOE) guidance. Fluoroscopy-echocardiography fusion imaging was facilitated by the EchoNavigator®-system (Philips Healthcare, Best, the Netherlands) allowing merging of echocardiographic and fluoroscopic images on the same display in real-time (Figure 2). No contrast was used. The initial strategy was to close the para-ring leak first and then review the degree of residual regurgitation. A transcatheter valve-in-ring implant would only be inserted if there remained significant residual regurgitation.

The right femoral vein was punctured under ultrasound guidance and a 6 Fr sheath was inserted. A temporary pacing wire was inserted via a 6 Fr sheath in the left femoral vein. Using a J-wire the right femoral sheath was exchanged for an 8.5 Fr SLO sheath and septal puncture was performed using a Brokenbrough needle. A BMW coronary guidewire was advanced through the Brokenbrough needle into the left upper pulmonary vein. After heparinisation, a double length 0.025-inch J-tipped guidewire (Terumo Glidewire, Terumo Medical Corp., Somerset, NJ, USA) was used inside a 6Fr internal mammary (IMA) diagnostic catheter to cross the defect using EchoNavigator. To provide more support, the Terumo glidewire was externalised around the left ventricular apex and across the aortic valve into the descending aorta. The IMA catheter was advanced over this and used to exchange for a 260 cm 0.035-inch J-tipped Amplatzer Super Stiff guidewire (AGA Medical Corp., Plymouth, MN, USA). The sheath was then exchanged for a destination catheter and a 12/5 mm Amplatzer vascular plug (AVP) III (St. Jude Medical) was deployed after confirmation of proper device positioning by TOE. Subsequent TOE showed that the para-ring leak was sealed (Figure 3). As there was now a residual, centrally directed, regurgitant jet due to failure of co-aptation of the anterior mitral valve leaflet on the vascular plug the decision was made to proceed with insertion of a transcatheter valve. A 29 mm valve implant size was selected based on the 30 mm annular ring.

Again the Terumo glidewire was passed into the descending aorta with an IM catheter and exchanged for the Amplatzer Super Stiff wire. This was used to exchange to a 16 French E Sheath (Edwards Lifesciences , Irvine , CA). A 29 mm SAPIEN 3 valve was positioned and deployed during rapid ventricular pacing.

Post-deployment TOE demonstrated an excellent valve position with no residual MR (Figure 4). We elected not to close the iatrogenic atrial septal defect as the shunt was small.

The patient was extubated in recovery and transferred to the coronary care unit for routine care. The patient was well and was discharged on the first postoperative day. Discharge transthoracic echocardiography showed only trivial MR.

Discussion

As seen in recent years with transcatheter aortic valve implantation, transcatheter mitral valve replacement has rapidly evolved to become one of the new frontiers in the field of interventional cardiology. Although it is still at an early stage it is likely that the number of patients with failed surgical mitral bioprostheses or mitral rings and prohibitive risk of a redo operation will continue to increase. Due to the challenging anatomy of the mitral valve and the wide variety of mitral pathology a variety of transcatheter approach options will always be required. The transapical approach has been used most frequently owing to the direct access and coaxiality with the mitral apparatus from the left ventricular apex. Alternative approaches include a transseptal approach and an off-pump transatrial approach through an anterolateral minithoracotomy [4]. There are obvious advantages to the less invasive transseptal approach where feasible. Important complications of this approach include valve embolisation, left ventricular outflow tract obstruction, and catheter induced ventricular perforation. Other limitations to this approach are the size of the delivery sheaths through the septum and also the long-term management of iatrogenic septal defects(iASD). Despite the rapidly expanding number of left atrial transcatheter procedures performed via a transseptal approach, the optimal management strategy of postprocedural iASD is currently unknown [5].

Accurate sizing of the mitral prosthesis can be challenging and it is important to emphasise that undersizing of the transcatheter implant can also lead to significant paravalvular regurgitation and the risk of haemolysis [6]. In this case performing the leak closure before implanting the valve may have several advantages. Firstly, if there is a good result from leak closure a transcatheter valve may be avoided. Secondly, it may be more difficult to cross the para-ring defect after transcatheter deployment. Kliger and colleagues described the complication of converting para-ring/extravalvular MR into severe intravalvular MR due to disruption of the mitral apparatus following Amplatzer vascular plug deployment [7]. We believe this is because the vascular plug may lead to failure of closure of the mitral valve leaflets as in our case. Therefore, a combined approach with an option to perform para-ring and transcatheter closure is likely to be important in this rapidly emerging field.

Transseptal treatment of a degenerative surgical mitral repair with significant paravalvular regurgitation is feasible in high-risk patients with para-ring leak repair followed by valve-in-ring implantation if required during the same procedure.

Disclosures

The authors have no direct or indirect commercial financial incentives associated with publishing this article.

Conflict of Interest

The are no conflicts of interest to declare.

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Figure Legend

Figure 1. Transoesophageal Echocardiography (TOE) showing A) The surgeon's 3D view of the mitral valve from the left atrial side showing a posteriorly located defect [arrow]; B) Severe paravalvular mitral regurgitation

Figure 2. Using EchoNavigator Fluoroscopy Fusion Imaging simultaneous colour Doppler can be overlaid on the operator screen to help crossing the defect, which is reflected as a dot.

Figure 3. A) Fluoroscopic Image of the vascular plug in relation to the annuloplasty ring; B) 3D TOE view of the vascular plug from the left ventricular side. Both views show a co-axial position.

Figure 4. A) Positioning of the 29mm SAPIEN 3; B) Final result with deployed SAPIEN 3 valve and the occluder plug.

Figure 1

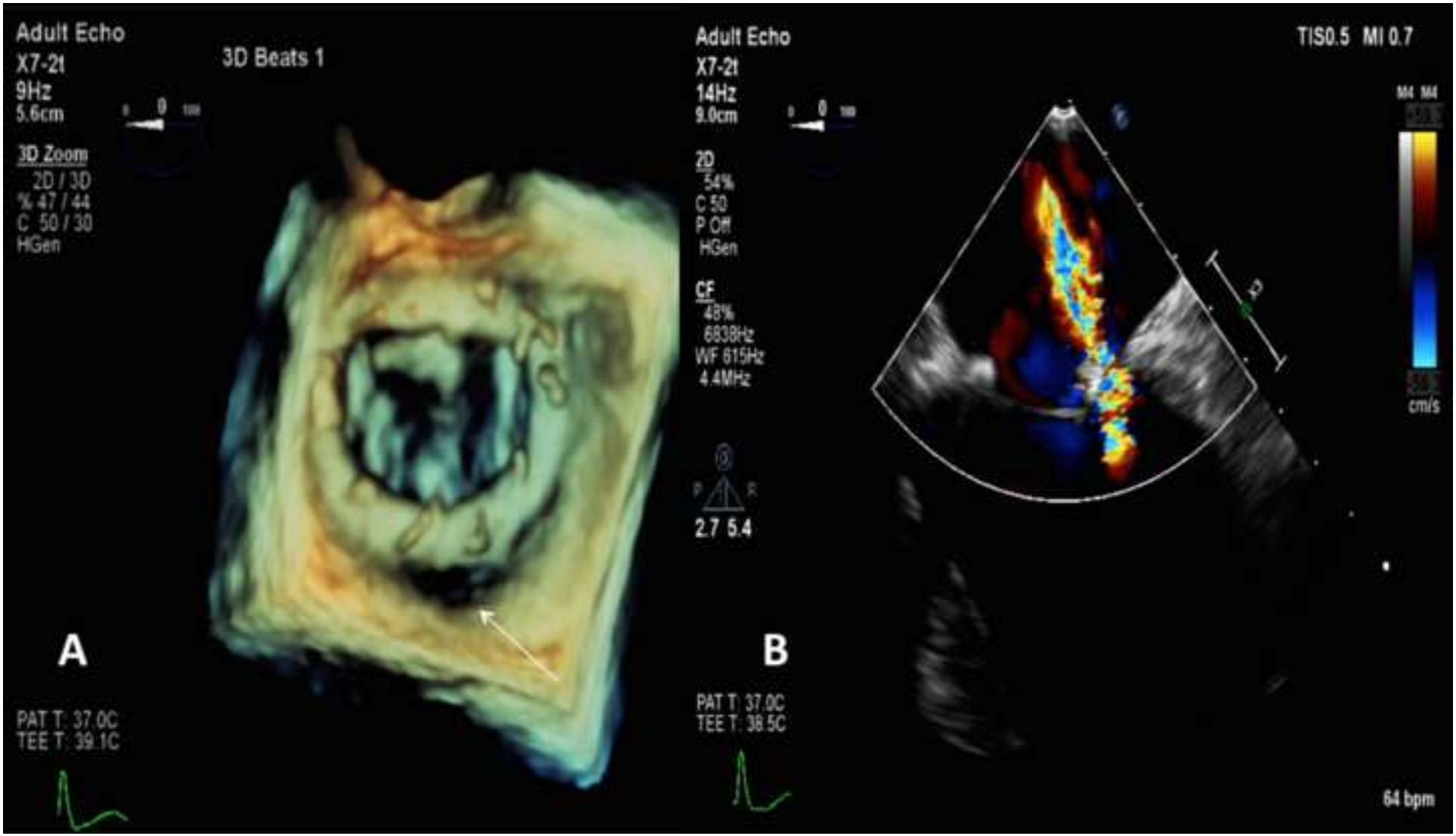
Adult Echo
X7-2t
9Hz
5.6cm
3D Zoom
2D / 3D
% 47 / 44
C 50 / 30
HGen
3D Beats 1
A
PAT T: 37.0C
TEE T: 39.1C
Adult Echo
X7-2t
14Hz
9.0cm
2D
54%
C 50
P Off
HGen
CF
48%
683Hz
WF 615Hz
4.4MHz
2.7 5.4
TIS0.5 MI 0.7
M4 M4
cm/s
B
PAT T: 37.0C
TEE T: 38.5C
64 bpm

Figure 2

Figure 3

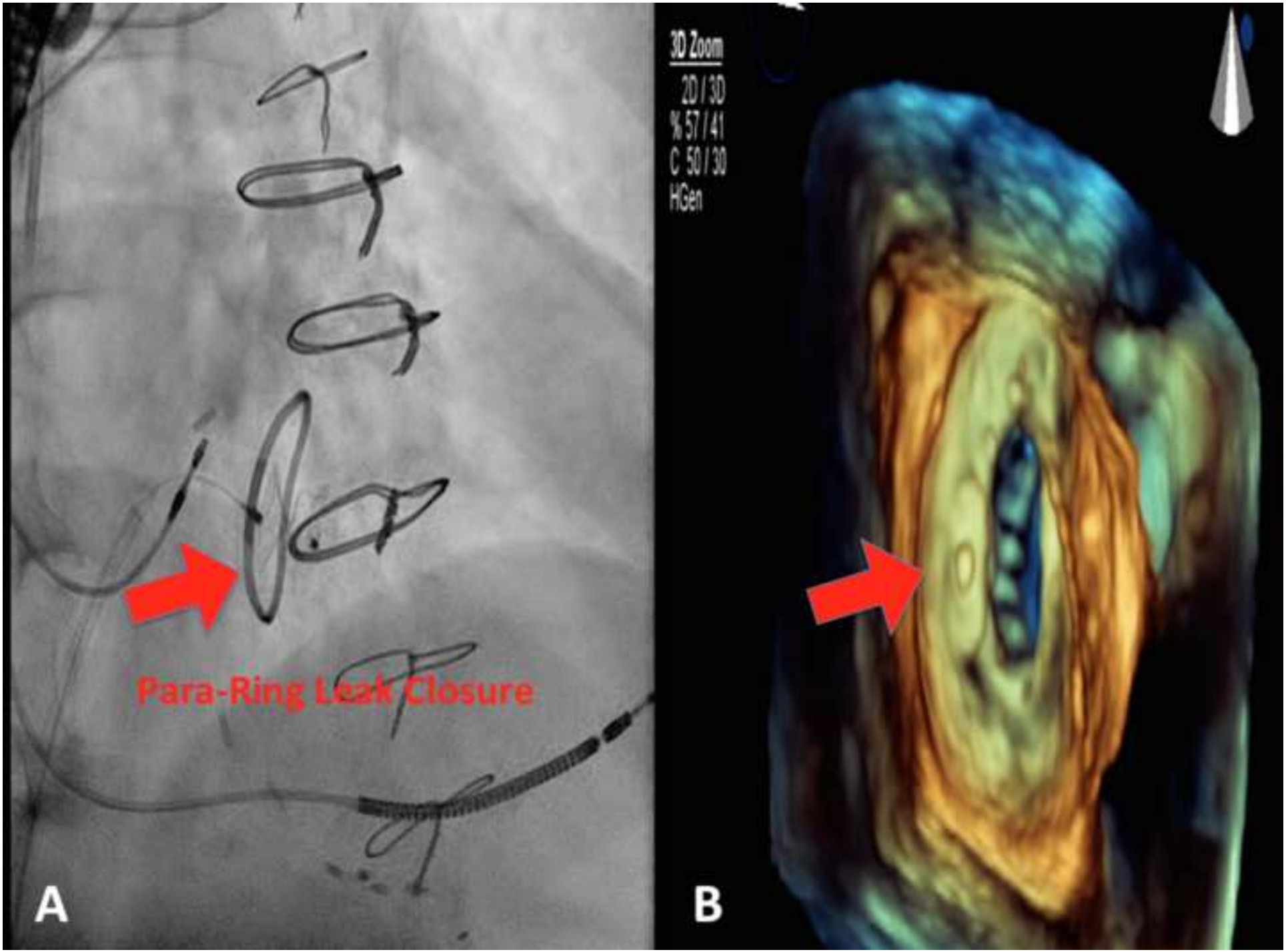

Figure 4


A
Adult Echo
X7-2t
14Hz
9.0cm
Live 3D
2D / 3D
% 41 / 41
C 50 / 30
HGen
3D Beats 1
TIS0.2 MI 0.5
B
78 bpm